Incentive Effects on Risk Attitude in Small Probability Prospects

Mathieu Lefebvre*, Ferdinand M. Vieider[#], and Marie Claire Villeval[§]

3 November 2009

Abstract: Most studies on the effect of incentives on risk attitude use within-subject designs. This may however raise an issue of sequentiality of effects as later choices may be influenced by earlier ones. This paper reports between-subject results on the effect of monetary stakes on risk attitudes for small probability prospects. Under low stakes, we find the typical risk seeking for small probabilities predicted by prospect theory. Under high stakes however risk seeking is dramatically reduced. This suggests that utility is not consistently concave over the outcome space, but may contain a convex section for very small amounts.

JEL-Code: C91, D81, D89
Keywords: Risk attitude, Incentives

* University of Liège, CREPP; email: Mathieu.Lefebvre@ulg.ac.be

[#] University of Lyon, CNRS, GATE; DIW; email: vieider@gate.cnrs.fr

[§] University of Lyon, CNRS, GATE; IZA, Bonn, and CCP, Aarhus. email: villeval@gate.cnrs.fr

1. INTRODUCTION

One issue that has been debated in the literature on decision making under risk is the effect of the provision of monetary incentives when studying risk attitudes. As for many other economic decisions (Camerer & Hogarth, 1999; Johansson-Stenman *et al.,* 2005; Kocher *et al.,* 2008), the effect of incentives is a potentially contentious issue, since many of the traditional findings on risk attitudes have been obtained with hypothetical payoffs.

After many years of heated debate, a consensus on these issues is emerging. Incentives are generally thought to leave the qualitative findings obtained with hypothetical studies intact (Battalio *et al.,* 1990). Quantitatively however, incentives seem to matter inasmuch as higher stakes increase risk aversion (Binswanger, 1980; Kachelmeier & Shahata, 1992). Also, while the size of real stakes matters, so do the nominal stakes in hypothetical choices (Kühberger *et al.,* 2002; Holt & Laury, 2002).

Although these studies have produced a generally coherent view, some methodological doubts remain. Indeed, they all report results from within-subject investigations of risk attitudes. While within-subject investigations are statistically powerful, they pose an issue of sequentiality of effects as later choices may be influenced by earlier ones. For instance, Kachelmeier & Shehata remark how “the transparent manipulation of prize level may have acted as a cue to subjects that their responses should change” (p. 1131). Read (2005) criticizes Holt & Laury (2002) for repeatedly telling subjects that certain choices were hypothetical while others were real.

To the best of our knowledge, no systematic investigation of between-subject effects of different stakes on risk attitude exists. Without agreeing with arguments that consider between-subject data the gold standard to which all other results need to be compared (Poulton, 1973), we think that such data may provide additional insights. We thus present some results on the effect of stake-size on risk attitudes for small probability prospects. Even though our attention is restricted to small probabilities for budgetary reasons, the changes in stakes are substantial, ranging from prizes of €4 ($6) to prizes of €100 ($150). While finding the typical pattern of risk seeking for small probabilities under low monetary stakes, we show that such risk seeking is substantially reduced under high stakes.

2. THE EXPERIMENT

2.1 Method

Subjects. The experiment was conducted at GATE, University of Lyon, France. Four sessions were run, with 20 subjects in two of them and 19 subjects in the other two. 64% of subjects were female, the average age was 22. On average subjects earned €22.58 for an experiment lasting less than 30 minutes.

Tasks. Subjects absolved several tasks in the course of an experiment on probability representations that is described in Lefebvre *et al.* (2009). Since different probability representations were found to have no effect, we will not further discuss this. Two tasks relevant for this paper were used. First, a context-free *neutral task* was used to elicit certainty equivalents for a binary lottery giving a 10% probability of winning a prize and a complementary probability of winning nothing. Certainty equivalents were elicited through a list of 26 choices (see Appendix).

Next, subjects' willingness to invest in a risky project was explored. Subjects were given an initial endowment, and the amount subjects were willing to invest was elicited through a list of 12 choices. Subjects were randomly assigned one of three probabilities of investment success ranging between 5.9% and 7%. Since ratios of elicited values to expected value (*EV*) are used for the analysis, this small variation in probabilities does not affect the results.

Incentives. A show-up fee of €5 was provided to all subjects. In the Low-Stakes condition, the prizes were €10 ($15) for the neutral task, and €4 ($6) for the investment task, with the latter to be financed out of an initial endowment of €0.60 (90¢). In the High-Stakes condition, all amounts were increased by a factor of 10, implying prizes of €100 ($150) and €40 ($60) for the neutral and investment tasks, respectively.

Encoding. The certainty equivalent (*CE*) and the willingness-to-pay for investment (WTP) were calculated as the mean between the two amounts for which subjects switched from the prospect to the certain amount (in the case of CE), or from the certain amount to the prospect (in the case of WTP).

Hypotheses. We expect that subjects will on average be risk seeking. Furthermore, we expect that risk seeking will be reduced significantly in the High-Stakes condition as compared to the Low-Stakes condition.

2.2 Results

Neutral task. Six subjects were dropped from the sample because they switched multiple times between the sure amount and the prospect. Under low stakes, we find risk seeking behavior, with a mean ratio of CE to EV of 1.66. We thus strongly reject the hypothesis that subjects are expected value maximizers ($t(39) = 8.53$, $p < 0.001$; all p-values are two-sided) in favor of the hypothesis that subjects are risk seeking. Only two subjects out of 40 can be classified as risk averse, three as risk neutral, and the remaining 35 as risk seeking (see table 1).

Table 1: Classification of subjects in terms of risk attitude

Tasks	Condition	Distribution of risk attitudes			
		Risk averse	Risk neutral	Risk seeking	Total
Neutral task	Low stakes	2 (5.00)	3 (7.50)	35 (87.50)	40 (100)
	High stakes	14 (43.75)	6 (18.75)	12 (37.50)	32 (100)
Investment task	Low stakes	5 (12.50)	2 (5.00)	33 (82.50)	40 (100)
	High stakes	9 (26.47)	2 (5.88)	23 (67.65)	34 (100)

Note: Relative frequencies in parentheses.

In the High-Stakes condition, subject are approximately risk neutral with an average ratio of CE to EV of 0.96. The hypothesis of risk neutrality cannot be rejected ($t(31) = -0.44$, $p = 0.67$). 14 subjects can be classified as risk averse, six as risk neutral, and 12 as risk seeking. We thus confirm that in the High-Stakes condition subjects are on average significantly less risk seeking than in the Low-Stakes condition ($z = 4.74$, $p < 0.001$, Mann-Whitney test).

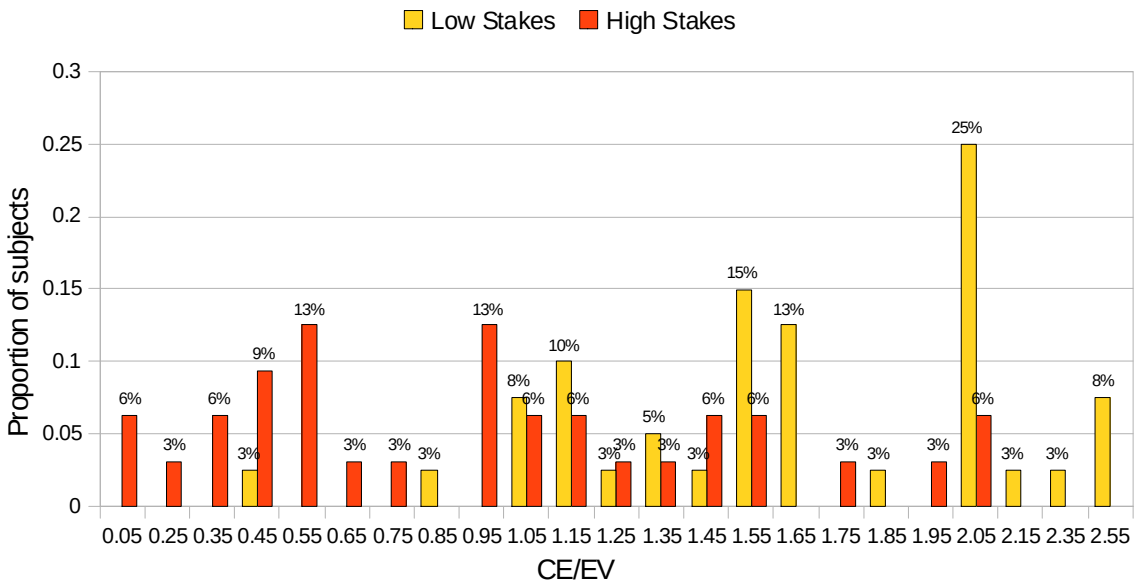


Figure 1: Ratio of CE to EV for Low and High Stakes

Investment Task. Six subjects were eliminated because they switched several times between investing and not investing. Again, we find risk seeking under low stakes, with a mean ratio of WTP to EV of 1.88. We easily reject risk neutrality ($t(37) = 6.05$, $p < 0.001$). Five subjects can be classified as risk averse, two as risk neutral, and 33 as risk seeking (see Table 1). Under high stakes we now also find risk seeking, with the mean WTP to EV ratio equal to 1.52. This time we reject risk neutrality also for high stakes ($t(33) = 3.31$, $p = 0.002$). Nine subjects are risk averse, two risk neutral, and 23 risk seeking. As hypothesized, subjects in the High-Stakes condition are on average less risk seeking than subjects in the Low-Stakes condition ($z = 1.93$, $p = 0.05$; Mann-Whitney test) (see also Figure 2).

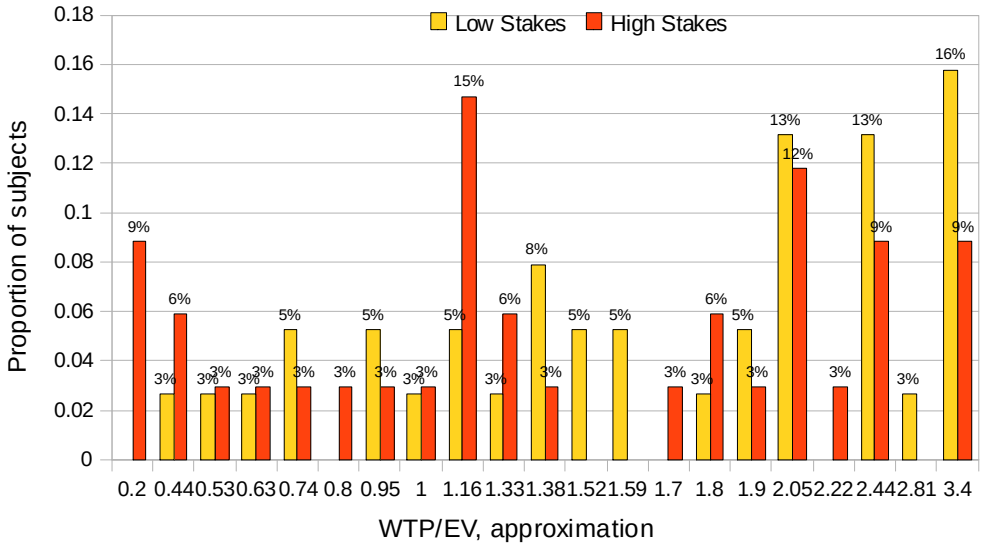


Figure 2: Proportion of subjects by WTP/EV ratio.

3. DISCUSSION

Our data confirm previous findings according to which individuals become more risk averse—or in our case less risk seeking—when high stakes are involved. This effect is very strong for a neutral task in which CEs are elicited. The effect is replicated in an investment task, though it is significantly less strong in the latter case ($Z = 1.49$, $p = 0.06$, Fisher's z test). Subjects are found to be risk seeking for small probabilities as predicted by the overweighting of small probabilities generally found in the literature (Abdellaoui, 2000; Bleichrodt & Pinto, 2000). While subjects become risk neutral under high incentives for the neutral task, they remain risk seeking for the investment task.

Under prospect theory the difference between low and high stakes can be explained with attitudes towards outcomes, since probability weighting is a purely probabilistic matter. The strong reduction in risk seeking we find is however somewhat troubling, since it is generally assumed that utility should be linear for such small amounts (Abdellaoui, *et al.*, 2008; Booij & van de Kuilen, 2009). A potential explanation would be that utility is not consistently concave over the outcome space, but rather contains a convex section for very small amounts (Bosch-Domènech & Silvestre, 1999; Markowitz, 1952).

According to this *peanut effect* (Prelec & Loewenstein, 1991; Weber & Chapman, 2005), the extreme risk seeking found would be the result of an increasing marginal utility of money for the small amounts of money offered for sure. Notice how this conceptual

framework may also explain why we find a weaker effect of monetary stakes in the investment task. Indeed, sure amounts used in the latter are even smaller and may thus be undervalued in both conditions, resulting in persisting risk seeking in the High-Stakes condition.

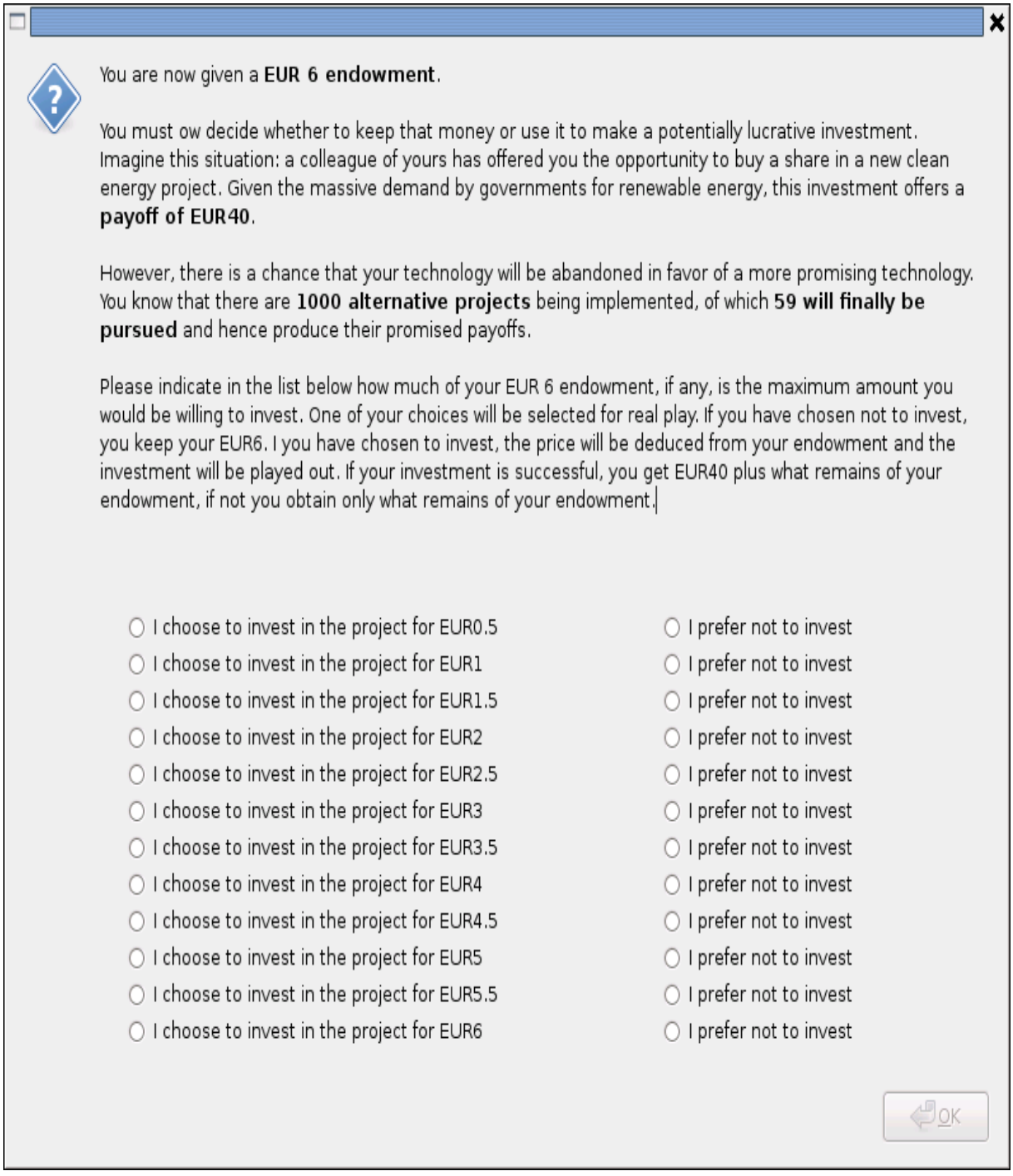
4. CONCLUSION

Although several studies investigating the effect of high monetary stakes on risk attitude exist, data reported are generally obtained by means of within-subject designs, and doubts have been aired about the soundness of that approach. We test the effect of high monetary stakes for small probability prospects in a between-subject design. While finding the typical pattern of risk seeking for small probability prospects under low stakes, such risk seeking is found to be substantially reduced under high stakes. This could be explained either by a peanut effect, according to which the utility curve may have a convex section for low gain amounts.

APPENDIX

Neutral Task (High stakes):

Investment Task: Choice List



REFERENCES

Abdellaoui, Mohammed (2000). Parameter-Free Elicitation of Utility and Probability Weighting Functions. *Management Science 46(1)*, 1497-1512.

Abdellaoui, Mohammed, Han Bleichrodt, & Olivier L'Haridon (2008). A Tractable Method to Measure Utility and Loss Aversion under Prospect Theory. *Journal of Risk and Uncertainty 36*, 245-266.

Battalio, Raymond C., John H. Kagel, & Komain Jiranyakul (1990). Testing Between Alternative Models of Choice under Uncertainty. *Journal of Risk and Uncertainty 3*, 25–50.

Binswanger, Hans P. (1980). Attitudes toward Risk: Experimental Measurement in Rural India. *American Journal of Agricultural Economics 62(3)*, 395-407.

Bleichrodt, Han, & José Luis Pinto (2000). A Parameter-Free Elicitation of the Probability Weighting Function in Medical Decision Analysis. *Management Science 46(11)*, 1485-1496.

Booij, Adam S., & Gijs van de Kuilen (2009). A Parameter-Free Analysis of the Utility of Money for the General Population under Prospect Theory. Journal of Economic Psychology, *forthcoming*.

Bosch-Domènech, Antoni, & Joaquin Silvestre (1999). Does Risk Aversion or Attraction Depend on Income? An Experiment. *Economics Letters 65*, 265–273.

Holt, Charles A., & Susan K. Laury (2002). Risk Aversion and Incentive Effects. *American Economic Review*, 1644-1655.

Johansson-Stenman, Olov, Minhaj Mahmud, & Peter Martinsson (2005). Does Stake Size Matter in Trust Games? *Economics Letters 88(3)*, 365–369.

Kachelmeier, Steven J., and Mohamed Shehata (1992). Examining Risk Preferences under High Monetary Incentives: Experimental Evidence from the People's Republic of China. *American Economic Review 82(5)*, 1120-1141.

Kocher, Martin G., Peter Martinsson, & Martine Visser (2008). Does Stake Size Matter for Cooperation and Punishment? *Economics Letters 99(3)*, 508–511.

Kühberger, Anton, Michael Schulte-Mecklenberg, and Josef Perner (2002). Framing Decisions: Hypothetical and Real. *Organizational Behavior and Human Decision Processes 89(2)*, 1162-1175.

Lefebvre, Mathieu, Ferdinand M. Vieider, & Marie Claire Villeval (2009). The Ratio Bias Phenomenon: Fact or Artifact? Working Paper.

Markowitz, H. (1952). The Utility of Wealth. *Journal of Political Economy 60*, 151–158.

Poulton, E. C. (1973). Unwanted Range Effects from Using Within-Subject Experimental Designs. *Psychological Bulletin 80*, 113–121.

Prelec, Drazen, & George Loewenstein (1991). Decision Making over Time and Under Uncertainty: A Common Approach. *Management Science 37(7)*, 770–786.

Weber, Bethany J, & Gretchen B. Chapman (2005). Playing for Peanuts: Why is risk-seeking more common for low-stakes games? *Organizational Behavior and Human Decision Processes 97*, 31–46.